Formative assessment in b-learning: effectively monitoring students learning

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ABSTRACT
One of the objectives of Higher Education is the development of learner autonomy so that students can become effective and efficient learners, with the capability for lifelong learning and for actively engage in the development of a knowledge society. Complementing formal education with learning management systems (b-learning) can provide the means to change from a learning-teaching transaction which is teacher-centred to one which is student-centred. In a study with polytechnic mechanical engineering undergraduate students enrolled in a blended learning course, formative self-assessment instruments in a learning management system were used to stimulate independent study and the improvement of academic achievement. The results indicated that the academic achievement in the course is influenced by the completion of self assessment, that the academic achievement of students who had carried out self-assessment tasks are higher than those who didn't and that the self-assessment grade is a significant predictor of the final course grade, with a very high positive association between both. This allows the use of these assessment instruments as monitoring tools for teachers and students.

Categories and Subject Descriptors
K.3.1 [**Computing Milieux**]: Computer Uses in Education–*computer-assisted instruction (CAI).*

General Terms
Measurement, Performance, Verification.

Keywords
assessment, learner autonomy, blended learning, higher education

1. INTRODUCTION
The student-centred teaching methodologies recommended by the Bologna Process aimed the promotion, among others, of the development of skills that allow the individuals to contribute actively to their own learning. This is only possible if students are autonomous learners, able to take responsibility for their own learning, adopting self-directed learning practices.

In the context of formal education, it is the teacher's responsibility to create opportunities for students to be able to exercise this autonomy. The use of learning management systems (LMS) offers a set of possibilities to help the promoting of autonomy in learning, including an extended number of instruments and self-assessment features, even if used in a more instructional perspective, that combine them with the face-to-face teaching [1]. The joint use of an LMS platform and face-to-face classes, in which the features and activities provided complement face-to-face interaction is usually designated by blended learning [2].

2. Assessment and learner autonomy
2.1 Formative assessment
For Hadji [3] formative assessment is the one that takes place during the teaching sessions, having as purpose to regulate and facilitate learning. Research [4] shows the existence of several conceptions of assessment, namely that: a) the formative assessment and summative assessment are distinguished by the instruments used; b) the formative assessment is subjective and the summative assessment is objective; and c) the formative assessment is any assessment that takes place in the classrooms.

The similarities and differences between formative assessment and summative assessment were aspects addressed by the Assessment Reform Group [5] showing that many of the activities carried out in the classroom allows teachers to gather information about students, and that this can be immediately used to help students.

Biggs [6] states that formative assessment is inseparable from teaching and that the effectiveness of different teaching methods is directly related to its ability to provide formative feedback, which helps students to monitor their own learning.

According to Santos [7], formative assessment is a process of external adjustment, which can occur at various moments: at the start of a task or a didactic situation – proactive regulation – throughout the learning process – interactive regulation – or after a sequence of learning with a certain length – retroactive regulation. To the author [7] the need for this kind of regulation means that students haven't already developed their ability for self-assessment, and is the teacher's responsibility to build a diverse set of facilitators' contexts, making the student become increasingly autonomous.

Looking for the systematizing of research on assessment, Black and Wiliam [8] published a review of the literature that has become one of the references in the field of formative assessment, being cited by numerous authors.

In this literature review, whose goals were to make a survey of the evidence about the implications of formative assessment in learning and verify the theoretical and practical issues associated with the formative assessment could be illustrated by the synthesis of the results of several studies reviewed, the authors conclude that the studies reviewed indicate that a practice strongly based on formative assessment produces significant and substantial gains in learning. This effect on learning was found both in children and in young people attending higher education, in various schools and in different countries. Furthermore, they concluded that the formative assessment provides greater support to students with greater difficulties, reducing the gap between the academic achievement of students.

In higher education, it was proposed [9] [10] that in addition to the certifying functions of assessment and its ability to promote of learning, usually ascribed to its summative and formative aspects, respectively, assessment should also promote lifelong learning. A central aspect of this third assessment function is that students must be much more active participants in their assessment than is implied in the formative and summative assessment, particularly regarding the assessment of their own academic achievement and the decision making of when to be assessed.

For Brown [11] the decision-making of when to be assessed is a step towards empowering students for lifelong learning, and should be an element to consider in formative and summative assessment. On the other hand, Yorke [12] emphasizes the important role that the formative assessment may have in clarifying what is intended for students to learn and that is not always explicit in the objectives of the curricular unit. The author [12], however, alert to the necessity of the existence of divergence (open tasks) in this type of assessment (and learning) activities because, while the feedback given by professor helps learning, it also means that the students' success is, to some extent, due to the tutoring of the teacher. I.e. in higher education is necessary that the monitoring done by the teacher does not collide with the responsibility and the control that the student must have on their own learning.

2.2 Learner autonomy

The idea of lifelong learning, allowing individuals to continuous improvement their performance and social contribution, is only possible if each individual is able to identify their learning needs and realize what to do to meet those needs. This means that lifelong learning depends on the ability of each individual to diagnose and evaluate what needs to be learned, what are essential aspects of an autonomous learner.

For Littlewood [13], the two main components of learner autonomy are the ability and the will, since individuals may be able to make independent choices, but not want to do, or they might want to make independent choices and not be able to. On the other hand, the ability and the will can be divided into two components: ability depends on having the knowledge about the options from which you can choose and have the necessary skills to carry out the choices that seem most appropriate. The will depends on having the motivation and the confidence to take responsibility for the choices made.

To Little [14], autonomy is a capacity-for freedom of spirit, for critical thinking, decision making and independent action. Presupposes and implies that the learner develops a particular psychological relationship with the process and content of learning. Learner autonomy will be shown not only in the way the learner learns but also in how transfers what was learned to broader contexts.

For the author [14], the basis for the learner autonomy in formal education context is the acceptance of responsibility for one's own learning; on the exercise of this responsibility depends the development of learner autonomy, in a continuing effort to understand what is being learned, why and how is learning taking place and with what degree of success; the effect of learner autonomy is to remove the barriers that easily stand between formal learning and the broader environment in which learners live. In this definition, the autonomy is the ability for a certain behaviour quite explicit and conscious that encompasses both the process and the content of learning.

Littlewood [13] argues that the popularity of learner autonomy is no surprise, since it is a concept that conforms to some of today's pedagogical concerns, in particular as what regards with the active involvement of learners, the use of "student-centred" methods and the goal of helping learners become independent of their teachers for their learning. As the broader goal of all education is to help students to act more independently in certain areas, a suitable teaching methodology is also, by definition, a methodology that promotes learner autonomy.

Crabbe [15] also refers the connection between learner autonomy and the student-centred methodologies, when defining learner autonomy as a movement consisting in change of a teaching-centred process for a process centred on learning and the student, with the change of learning responsibility from teachers to students. The focus of this movement is the ability of the students to be responsible for their own learning, more specifically on the issue of decision-making in the learning process. Traditionally, teachers make decisions about the goals and on the ways to achieve these goals. To the author [15] the challenge of learner autonomy movement is to take into account the ability of students to define learning objectives and to organize their learning activities. This would be achieved with greater flexibility in learning activities, and students' ability to take advantage of this flexibility. In this perspective, the teacher emerges as the facilitator which provides the conditions for the exercise and development of autonomy, that the student should be able to exercise. So it´s claimed that, in higher education, methodologies focused on student learning are adopted.

2.3 Learning Management Systems

From the perspective of Gomes [16], the use of learning management systems (LMS) is done in two ways: a more traditional, centred on content presentation and assessment of academic achievement of students and oriented to autonomous study and individual learning, and another more focused on the nature of the learning process and using instruments that make it possible to obtain evidence of the learning process and skills developed by the students.

In more traditional way, assessment instruments are based on the automation capabilities of LMS (as, for example, moodle) and features made available by them, such as multiple-choice tests, filling the gaps tests, among others, eventually with automatic correction by the system and automatic generation from a database of questions and with automatic response time. In the more process-oriented way, it is necessary to consider other types

of instruments and techniques, such as discussion forums, portfolio development and cognitive maps building.

The use of computer based assessment with face-to-face teaching is, according to Gomes [16], an asset to the extent that allows students the opportunity to have, at any time during their learning process, access to assessment processes with self-regulatory functions and formative assessment, although they may be limited with regard to aspects like the ability of critical thinking, analysis and synthesis.

Not all authors agree with the existence of this limitation in multiple-choice tests. Leclercq [17] suggests, for example, the use of general solution implicit questions as a way to improve cognitive vigilance, contradicting the mechanical tendency to answer questions, which is the opposite of a critical spirit, analysis and evaluation of the formulation of the problem, which promotes cognitive flexibility. In this kind of multiple-choice questions, the student is presented with a set of solutions, and he has to choose the answer from the following alternatives: none of the proposed solutions; ALL the proposed solutions; It is not possible to determine what is the best solution for lack of data; The question is absurd, so it makes no sense to try to find the solution. So, the possible solutions are always the same and of a general nature.

On the other hand, the use of multiple-choice tests through LMS relieves the workload for teachers, allowing the increase of assessment moments, immediate and automatic feedback when is needed by the students and not only with the teacher is available.

One can thus say that the multiple-choice tests in LMS are an effective way to encourage students to make their own self-assessment, which constitutes an essential element of the teaching-learning process, as Hattie [18] from the analysis of some thousands of studies about teaching, concluded that the factor that most influences academic achievement of students is students' self-assessment (effect size 1,44).

3. METHOD

3.1 The context

The aim of this study was to check to what extent formative self-assessment activities implemented in a LMS in a specific curricular unit was related with the academic achievement, in order to explore its potential as a learning monitoring tool, by formulating these objectives:

1) To check if the completion of self-assessment activities in LMS favours the approval in the curricular unit.

2) To check if the final grades of students who did the self-assessment activities in LMS are statistically different from those who did not.

3) To check for the existence of a correlation between self-assessment grades and final grades.

The context in which self-assessment activities in LMS was implemented was the following: due to the high number of students enrolled (474 students) in 2011/12 in a second year curricular unit (the study cycle has three years, with 180 ects), and because 30% already attended classes in previous years, but had failed, it was allowed that these students could attend the curricular unit in blended learning. 147 students (31,0%) choose to do it.

In the LMS (moodle) videos of the lectures were made available, accompanied by theoretical sheets with blanks that students should print and fill out during the screening of the videos. Self-assessment questionnaires about the videos content were made available, with immediate feedback by means of a grade and the suggestion of whether or not attend face-to-face tutorials sessions on the subject. These questionnaires were optional and its grade had no impact on the final grade of the curricular unit (final written exam), therefore, being nothing more than formative self-assessment tools. Largely, the questionnaires had general implied solution as a way to improve cognitive vigilance.

There were also available in the LMS exercises and problems sheets to solve, solved exercises and problems sheets, explanatory videos of the resolution of some typical exercises and problems, from the most simple to the most complex, as well as other supplementary supporting material tables and diagrams. When needed, it was also made available self-assessment questionnaires on aspects more directly related with the resolution of exercises problems.

Overall, a total of 10 self-assessment questionnaires were proposed to students covering all contents of the syllabus. Weekly, optional face-to-face tutorials sessions existed, for clarification of doubts and coaching of students if they so wished.

The remaining 327 students enrolled (69,0%) attended the curricular unit in face-to-face classes with theoretical lectures and weekly practices.

The summative assessment method was the same to all the students and consisted of two written exams (one halfway in the semester and another at the end). The final grades were obtained from the weighted average of both exams (the weights were 0,4 and 0,6 for the first and second exams, respectively). There was still the possibility of a final, global examination if needed.

3.2 Participants

All participants were students enrolled in the same curricular unit; two separate samples were used, one for the first and second objectives and one for the third. For the first and second objectives (check if the completion of self-assessment activities in LMS favours the approval in the curricular unit) the students considered were the ones that, having chosen b-learning, attended the exams, obtaining a final numerical grade in this curricular unit (N=132; 27,8% of the enrolled students; see table 1).

For the third objective of this study (check for the existence of a correlation between self-assessment grades and final grades) the students considered were the ones that, having chosen b-learning, did the self-assessment activities and attended the exams, obtaining a final numerical grade in this curricular unit (N=113; 23,8% of the enrolled students; see table 1).

Table 1. Distribution of students by type of attendance

Students	N	Approval	Fail	Quit
1) TOTAL Enrolled	474	229	164	81
1.1) Face to face classes	327	138	123	66
1.2) Blended-learning	147	91	41	15
1.2.1) Self-assessment	118	83	30	5
1.2.2) No self-assessment	29	8	11	10

3.3 Procedure

The strategy adopted for the implementation of the research plan is descriptive, using documental analysis of the curricular unit grades reports and the grades records of moodle. All data were collected in the school year 2011/12.

To assess whether the approval in the curricular unit depended on the completion of self-assessment questionnaires in moodle, a Chi-square test of independence implemented in statistical analysis software SPSS Statistics (v. 19; IBM SPSS), was used, as described in Marôco [19]. It is considered an error probability of type I (α) of 0,05 in all inferential analysis.

The significance of the difference between the final grades of students who did the self-assessment questionnaires and those who did not, was assessed with the Student's t test for independent samples. The assumptions for this statistical test, namely the normalities of the distributions and the homogeneity of variances were assessed, respectively, with the Kolmogorov-Smirnov test (KS_NOSELF-ASS(19) = 0,141; p = 0,200; KS_SELF-ASS(113) = 0,150; p = 0,000) and with the Levene's test based on the median (F(1,130) = 0,065; p = 0,800).

In spite of the absence of normality of the dependent variable in the participants group that completed self-assessment, it was considered that the Student's t test is robust to violations of normality when the values of skweness (sk=0,239) and kurtosis (ku=0,165) are not very high [19]. The statistical analysis software SPSS Statistics (v. 19; IBM SPSS) as described in Marôco (2011), was used to perform these statistical tests. Differences between average values were considered statistically significant when the p-value of the test was less than or equal to 0,05.

To verify the existence of a correlation between self-assessment grades and final grades, a simple linear regression (enter method) was used, in order to predict the final grades (dependent variable) as a function of self-assessment grades (independent variable). The assumptions of the model, namely the normal distribution, homogeneity and independence of errors were analysed. The first two assumptions was validated graphically and the assumption of independence was validated with the Durbin-Watson statistic (d=1,953) as described in Marôco [19]. The verification of the existence of outliers (standardized residue above two standard deviations) was also done. All analyses were performed with SPSS Statistics (v. 19; IBM SPSS). It was considered for all analysis an error probability of type I (α) of 0,10.

4. RESULTS

Regarding the possibility of the curricular units approval be favoured by the completion of self-assessment questionnaires in moodle, it was observed a larger number of students with approval amongst those who did the self-assessment questionnaires in moodle (N=83; 62,9%), compared to those who did not (N=30; 22,7%). The inferential statistical analysis allows the assertion that the occurrence of approval is not independent of the completion of self-assessment questionnaires in moodle (chi-square(2)=7,464; p=0,006; N=132).

Students who that did not complete the self-assessment questionnaires in moodle obtained, on average, a final grade of 8,21 (in 0-20 score; standard mean error =0,740) while students who did it, obtained, on average, a final grade of 10,79 values (in 0-20 score; standard mean error =0,347) (see table 2).

According to Student's t-test, the observed differences between the final grades mean of the two groups are statistically significant (t(130)=-2.867; p=0,005).

Table 2. Mean and standard-deviation in final grades of the two groups (did self-assessment and did not self-assessment)

DID SELF-ASSESSMENT	N	Mean	SD	Mean standard error
YES	113	10,79	3,685	0,347
NO	19	8,21	3,225	0,740

The simple linear regression allowed the conclusion that the self-assessment grade "SELFGRADE" (β=0,940; t(108)=28,383; p=0,001) is a significant predictor of the final grade "FINALGRADE", having a very high positive association between the two variables. The adjusted final model is FINALGRADE=2,394+0,527xSELFGRADE. This model is highly significant and explains a high proportion of the variability of the final grade (F(1)=805,589; p<0,001; R^2=0,883). Five outliers were identified and removed.

5. DISCUSSION AND CONCLUSIONS

The fact that the students who did not do the self-assessment questionnaires (N=19) are fewer than those who did (N=113), did not allowed the adoption of an experimental design with two groups of participants selected randomly, what constitutes a limitation of the study as regards to the comparison between the final grades of the students of these two groups. On the other hand, one can also raise the issue that the group of students who completed the self-assessment questionnaires were more motivated and willing to invest in the curricular unit, than the group that did not, being this the motive, and not the completion of self-assessment questionnaires, that contributed to the difference in the final grades. For this reason, the results of the comparison of these two groups should be regarded with caution.

Nevertheless, when comparing the self-assessment questionnaires grades with final grades, considering only the participants who complete self-assessment (N=113), there is a very high positive association between both, which leads to the conclusion that a greater investment in formative self-assessment improves academic achievement of students (b-learning students had at least two enrolments in the curricular unit; nothing can be concluded in respect to students enrolled for the first time in the curricular unit, because these were not participants of the study).

Although the study does not allow conclusions to be taken regarding the reasons that lead to this greater investment on the part of students, it shows that: a) students find these kind of activities helpful and interesting, investing in them a considerable amount of time; b) these kind of activities (multiple-choice questionnaires with general solution implicit questions) allows the discrimination of students based on their learning difficulties; and c) this kind of assessment activities have a key role in monitoring the premature drop-out situations that detected in a timely manner, can still be recovered. It is suggested, therefore, that even in traditional face-to-face learning scenarios, these type of instruments implemented in LMS are used to allow the implementation of formative assessment as a complement. The possibility of frequent formative feedback for students, is an important tool to self-regulation, allowing teachers to effectively monitor students learning.

6. REFERENCES

[1] Camerino, O. 2011. Evaluación formativa y tecnologias da la información y la comunicación (TIC). In Victor M. López Pastor (Coord.), *Evaluación formativa y compartida en Educación Superior: propuestas, técnicas, instrumentos y experiencias*, 127-149. Madrid: Narcea, S.A.

[2] Monteiro, A. 2011. *O currículo e a prática pedagógica com recurso ao b-learning no ensino superior* (PhD thesis). http://hdl.handle.net/10216/61945

[3] Hadji, C. 1993. *A Avaliação, regras do jogo: Das intenções aos instrumentos* (4ª ed.). Porto: Porto Editora.

[4] Fernandes, D. 2006. Para uma teoria da avaliação formativa. *Revista Portuguesa de Educação*, 19, 2, 21-50.

[5] Assessment Reform Group. 2006. *The role of teachers in the assessment of learning*. http://www.assessment-reform-group.org/ASF %20booklet%20English.pdf

[6] Biggs, J. 1999. *Teaching for quality learning at university.* Buckingham: Open University Press

[7] Santos, L. 2002. Auto-avaliação regulada: porquê, o quê e como? In Paulo Abrantes and Filomena Araújo (Orgs.), *Avaliação das Aprendizagens. Das concepções às práticas*. 75-84. Lisboa: Ministério da educação, Departamento do Ensino Básico.

[8] Black, P. & Wiliam, D. 1998. Assessment and classroom learning. *Assessment in Education: Principles, Policy & Practice*, 5, 1, 7-74.

[9] Boud, D. 2004. Assessment and learning: Contradictory or complementary? In P. Knight (Ed.). *Assessment for Learning in Higher Education*. 35-48. London: Routledge.

[10] Boud, D. & Falchikov, N. 2006. Aligning assessment with long-term learning. *Assessment & Evaluation in Higher Education*, 31, 4, 399-413

[11] Brown, S. 2004. Assessment for learning. *Learning and Teaching in Higher Education*, 1, 81-89

[12] Yorke, M. 2003. Formative assessment in higher education: moves towards theory and the enhancement of pedagogic practice. *Higher Education*, 45, 477–501.

[13] Littlewood, W. 1996. Autonomy: an anatomy and a framework. *System*, 24, 4, 427-435.

[14] Little, D. 1991. *Learner Autonomy 1: Definitions, Issues and Problems*. Dublin: Authentik.

[15] Crabbe, D. 1999. Defining the field. In Cotterall, S., & Crabbe, D. (Eds.). *Learner Autonomy in Language Learning: Defining the Field and Effecting Change*. 3-9. Frankfurt: Peter Lang.

[16] Gomes, M. J. 2009. Contextos e práticas de avaliação em educação online. In Guilhermina Lobato Miranda (Org.), *Ensino online e aprendizagem multimedia*. 125-152. Lisboa: Relógio D'Água.

[17] Leclercq, D. 2001. Desafios actuais à Pedagogia Universitária. In C. Reimão (Coord.), *A Formação Pedagógica dos Professores no Ensino Superior*. 29-51. (1ª edição.). Lisboa: Edições Colibri.

[18] Hattie, J. 2009. *Visible Learning; a synthesis of over 800 meta-analyses relating to achievement*. London: Routledge.

[19] Marôco, J. 2011. *Análise Estatística com o SPSS Statistics.* Lisboa: ReportNumber.